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# Overview of Facility Impacts

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Third International Workshop on High-Powered Laser  
Chamber Issues - Focus: Debris and Shrapnel  
Livermore, CA, United States  
June 2, 2008 through June 4, 2008

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# 3<sup>rd</sup> International Workshop on High-Powered Laser Chamber Issues

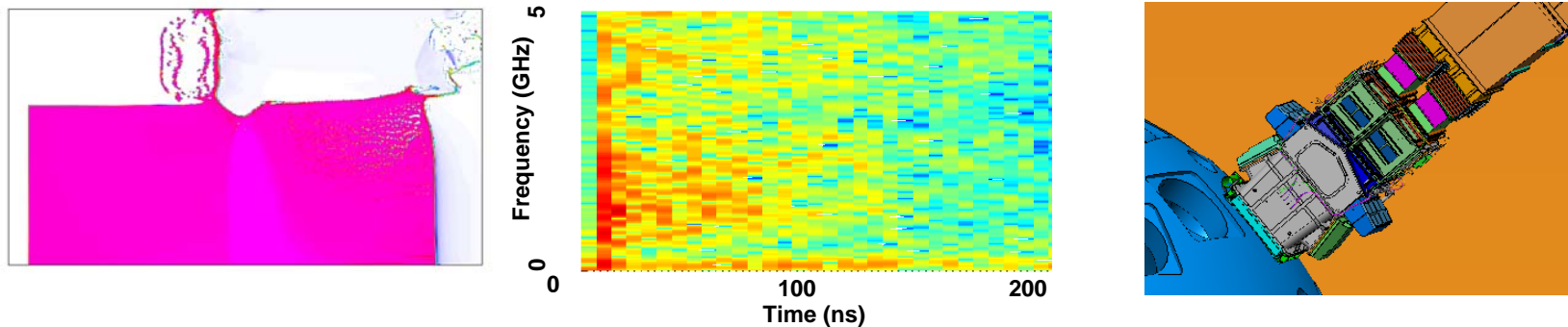
Focus: Debris and Shrapnel

June 2-4, 2008

NIC

QuickTime™ and a  
Photo- JPEG decompressor  
are needed to see this picture.

## Overview of Facility Impacts



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# **Facility impacts affects operation costs & schedule**

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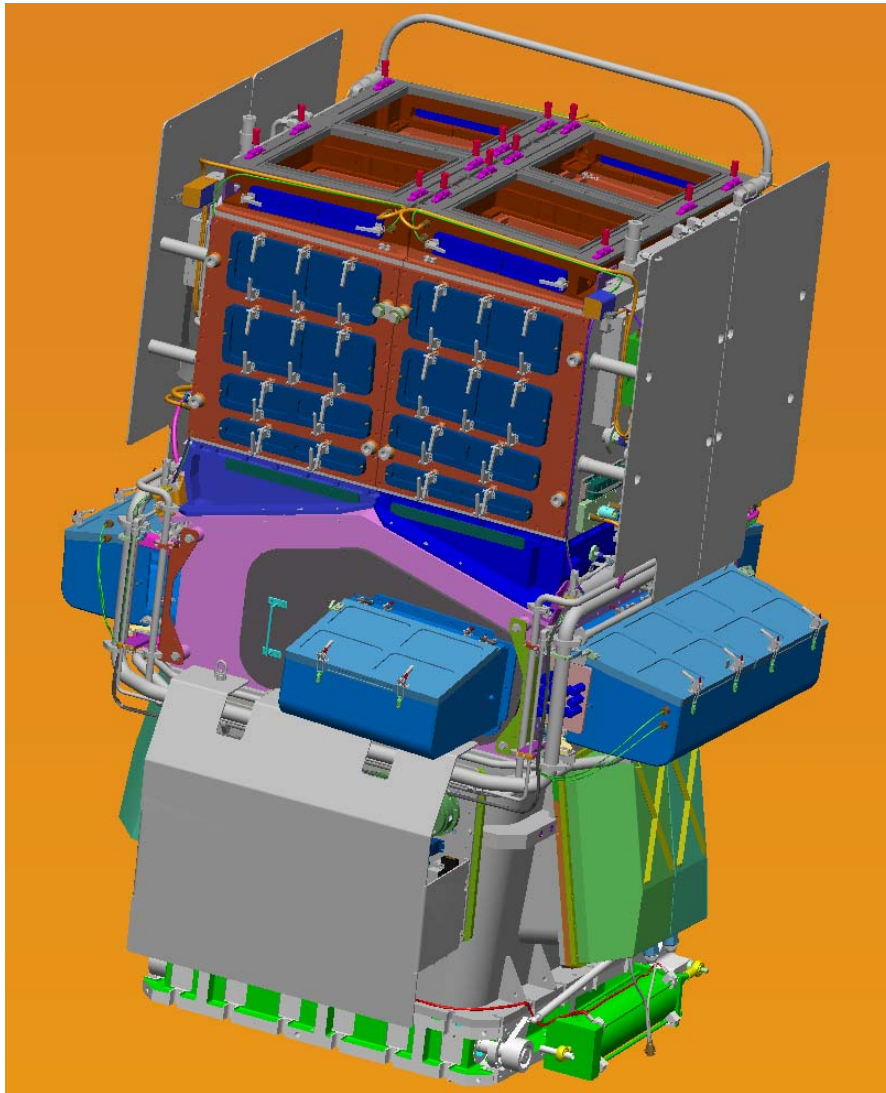
- **Debris and shrapnel impacts optics and diagnostics**
- **Laser fluence impacts optics even with and without debris**
- **Electromagnetic pulses impact diagnostics and utilities**
- **Neutrons and gamma radiation impacts diagnostics and schedule via limits on worker dose**
- **Controlling these impacts requires complex 3D simulations and experiments**

## **Debris and shrapnel mitigation is effective**

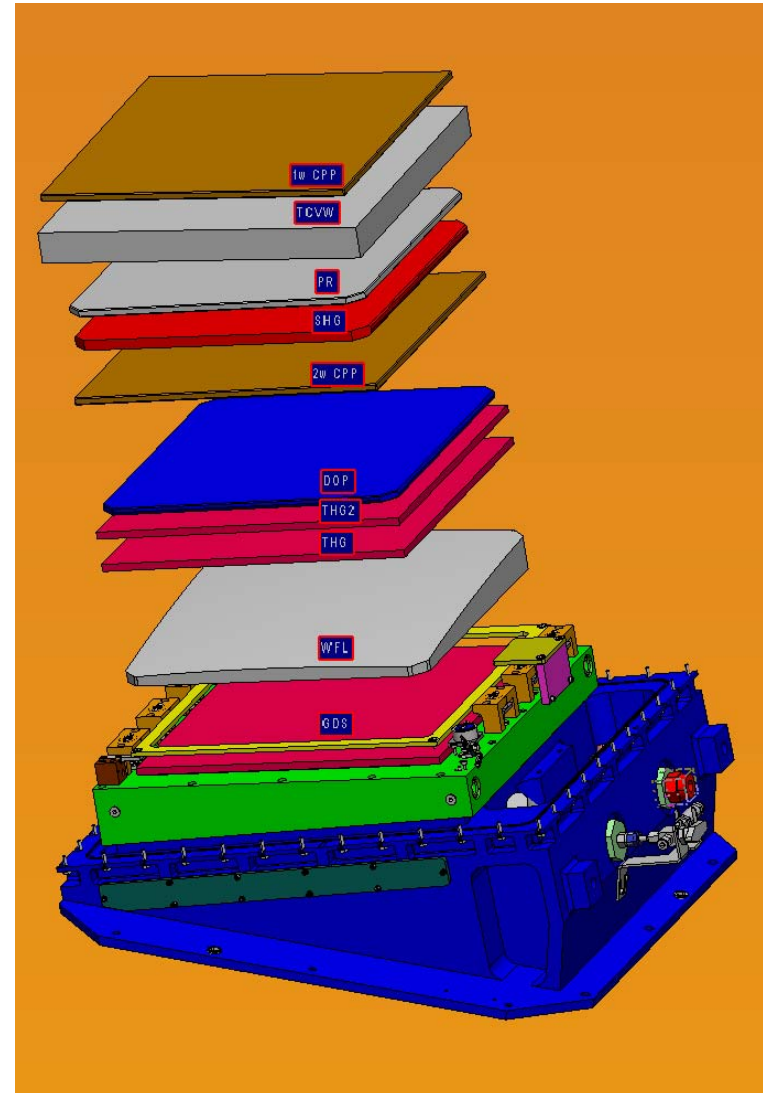
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- **Tilt of Ta pinhole on NEL shots allowed for image of hydro shots**
- **Assessments have been completed or in progress for early NIF**
  - **Si cooling rings, keyhole cone, re-emit filters, etc.**
- **Collimators for ARC backlighting will be studied soon**
- **High-energy density and basic science campaigns targets are being defined**
- **Goal is to stay with 1-mm thick DDS's (LMJ plans 2-mm thick) but keeping 3-mm thick DDS as backup**

A manual DDS will be used initially to protect other optics followed by a DDS ten-slot cassette



FOA with DDS cassettes

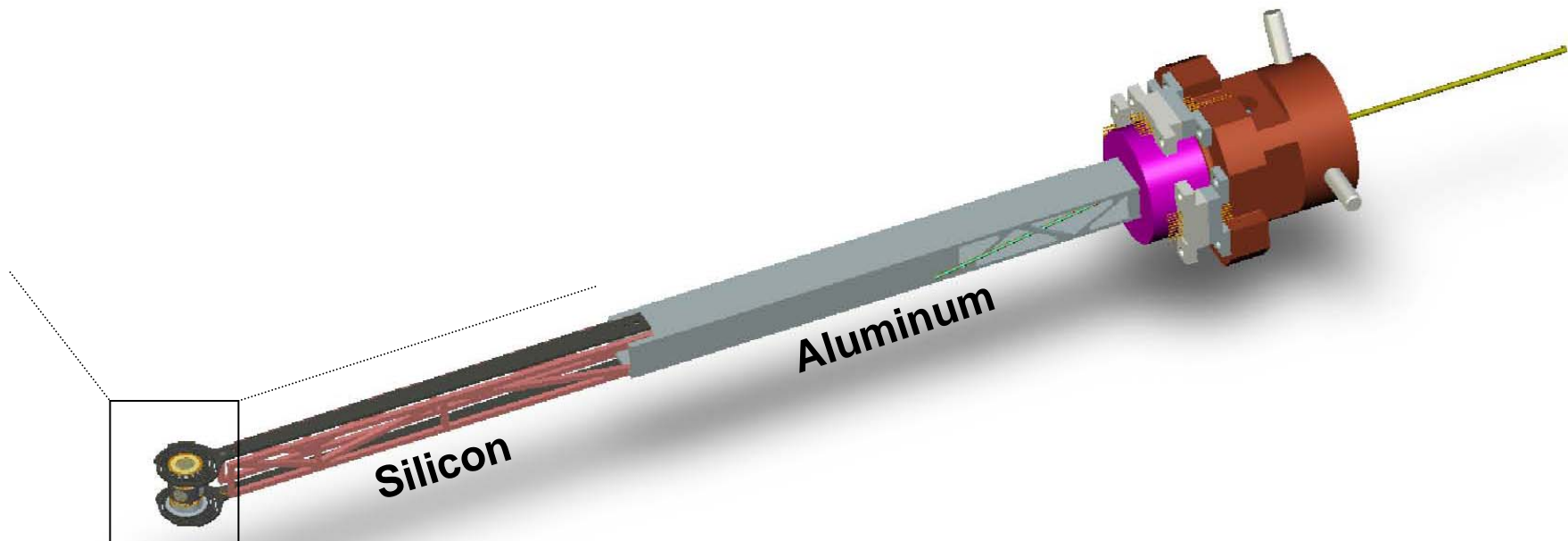


“other optics” in FOA

# In general, we are concerned with shields, cooling rings, pinhole arrays, etc. near TCC

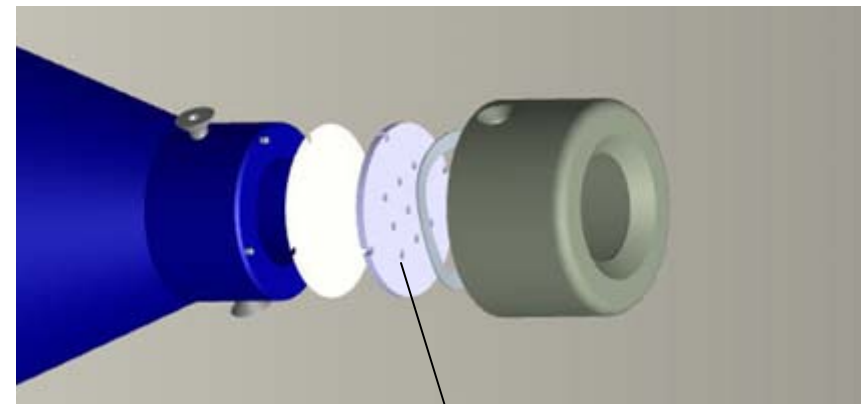
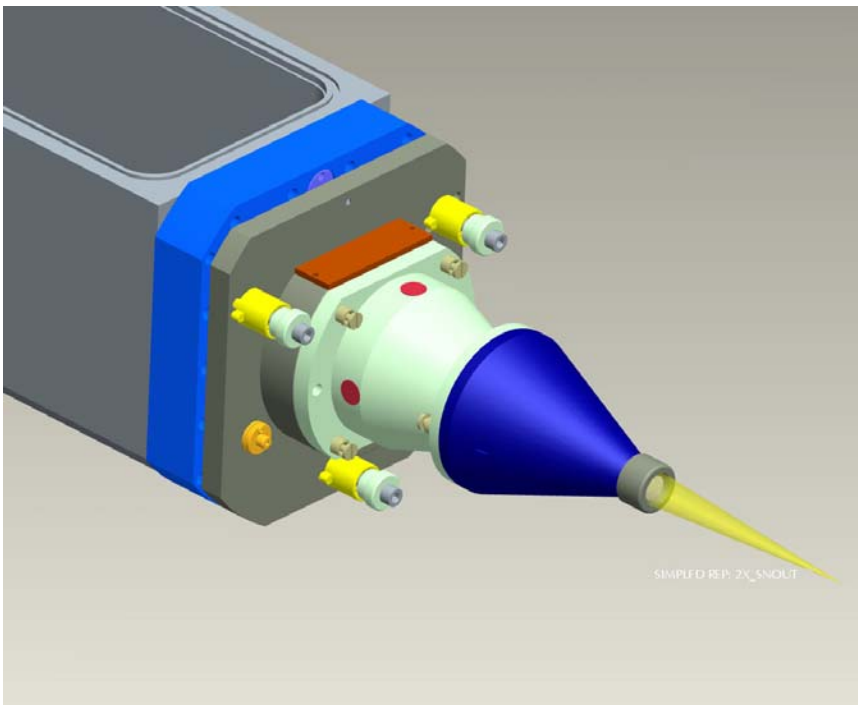
For cryogenic targets, we have studied Si cooling rings and impact of Al case surround high-Z inner liner

QuickTime™ and a  
TIFF (LZW) decompressor  
are needed to see this picture.



# We use collimators before and after pinhole arrays to reduce size and number of shrapnel fragments

- In some cases, e.g., re-emit, filters are so thin that no fragments are allowed to strike filters
- We are determining if tilting of pinhole arrays is required for any of the campaigns



Pre Collimator

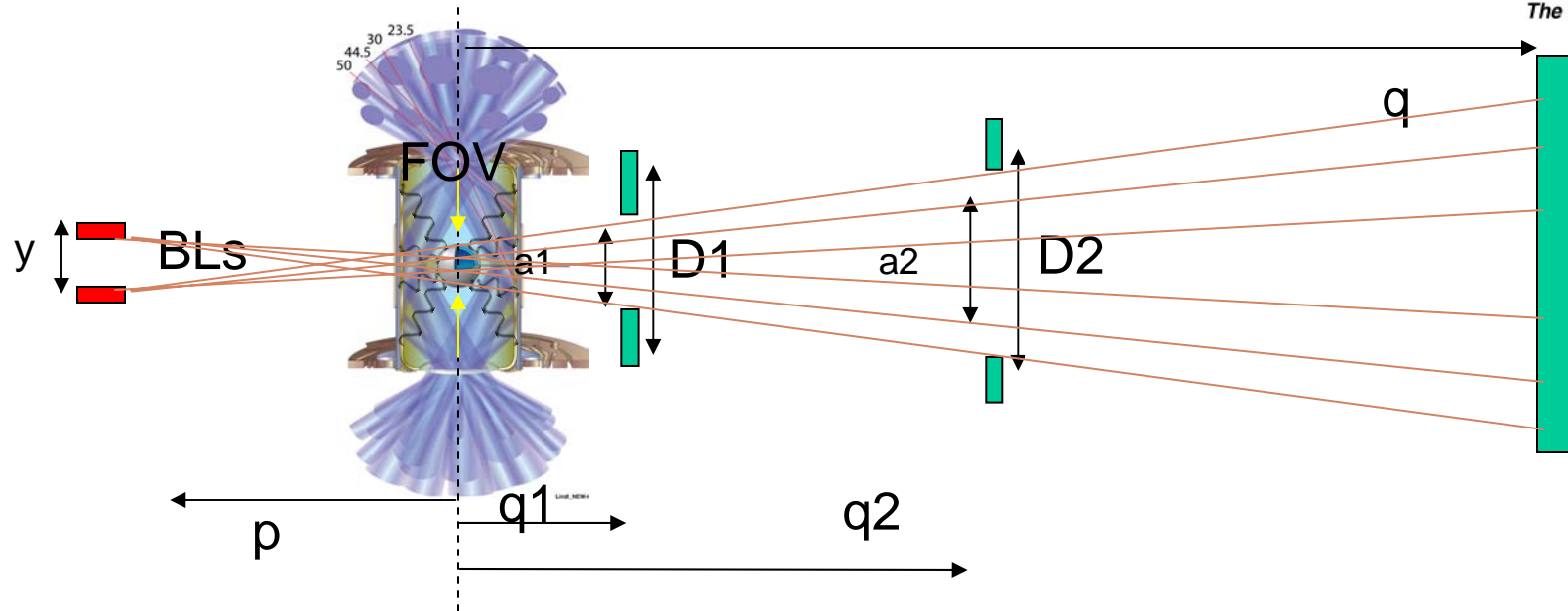
Pre Filter

Pinhole Array

Post Collimator



# Assessment of double collimators planned for ARC backlighters is our next major task



**First collimator is Ta/Pt and 1.5 mm thick**

**Second collimator is Ta and 3 mm thick**

D2 is rectangle, since Hohlraum  
is cylinder

D1 can be square

$q_1 = 4.0$  mm

$q_2 = 41.0$  mm from TCC, up to 10mm

D1 = 1.0 mm (square shape)

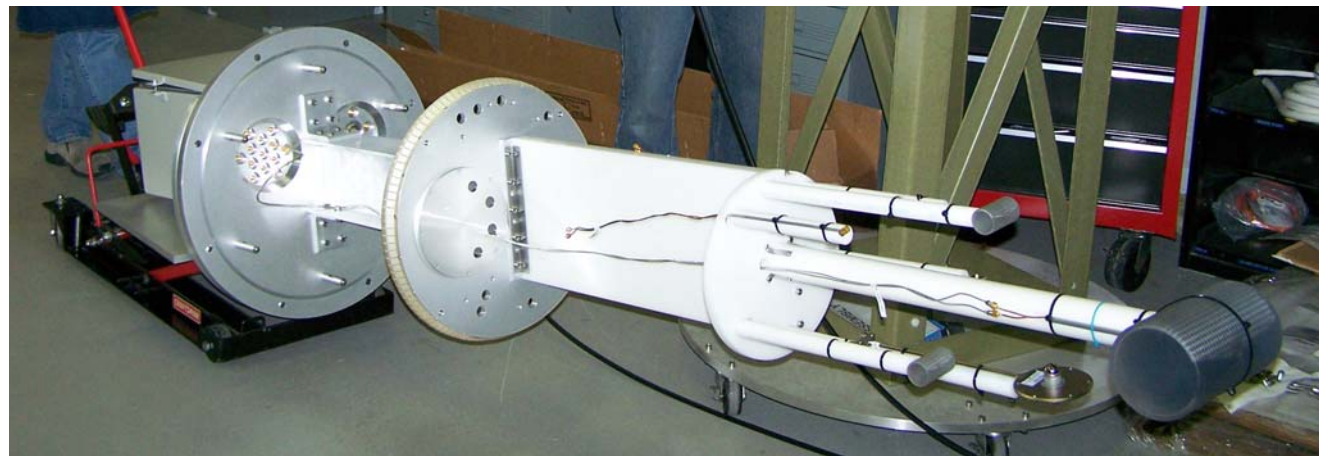
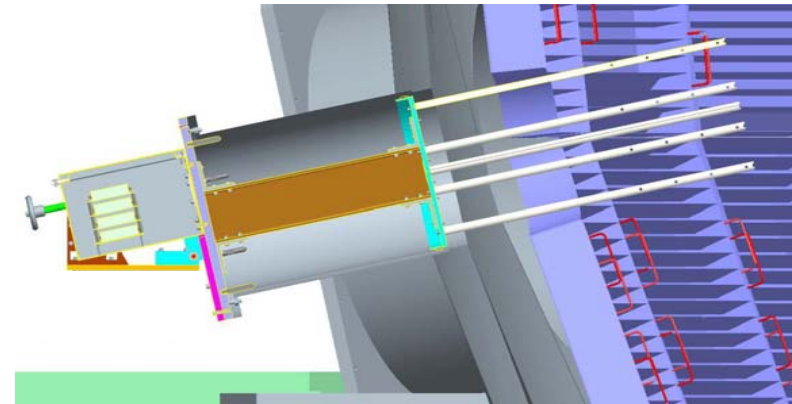
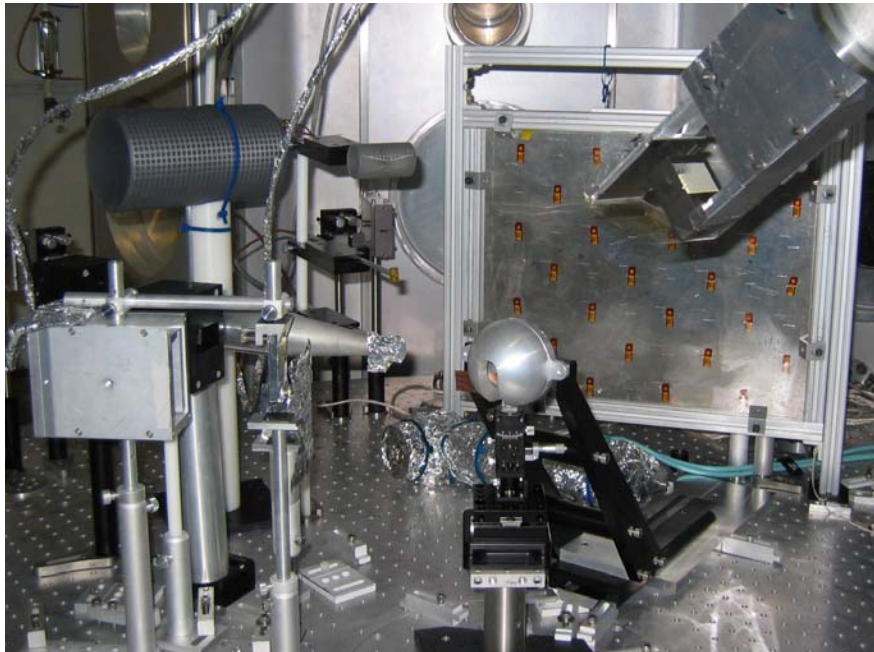
D2 = 10.0 mm X 7.0 mm (rect. shape)

$a_1 = 236$   $\mu\text{m}$ , (circular shape)

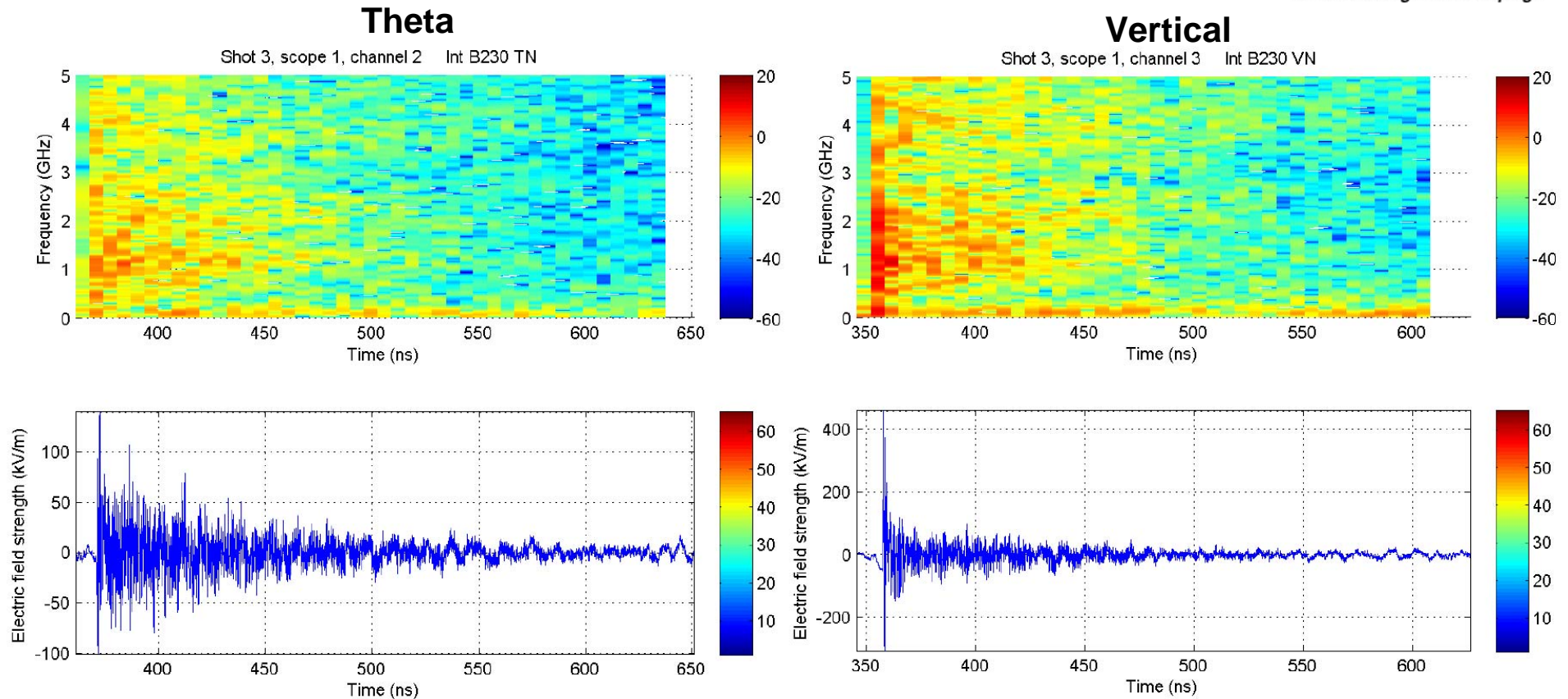
$a_2 = 572$   $\mu\text{m}$ , (square shape)

$y = 260$   $\mu\text{m}$

# Electromagnetic pulses (EMP) will be measure on NIF using probes tested at Titan facility

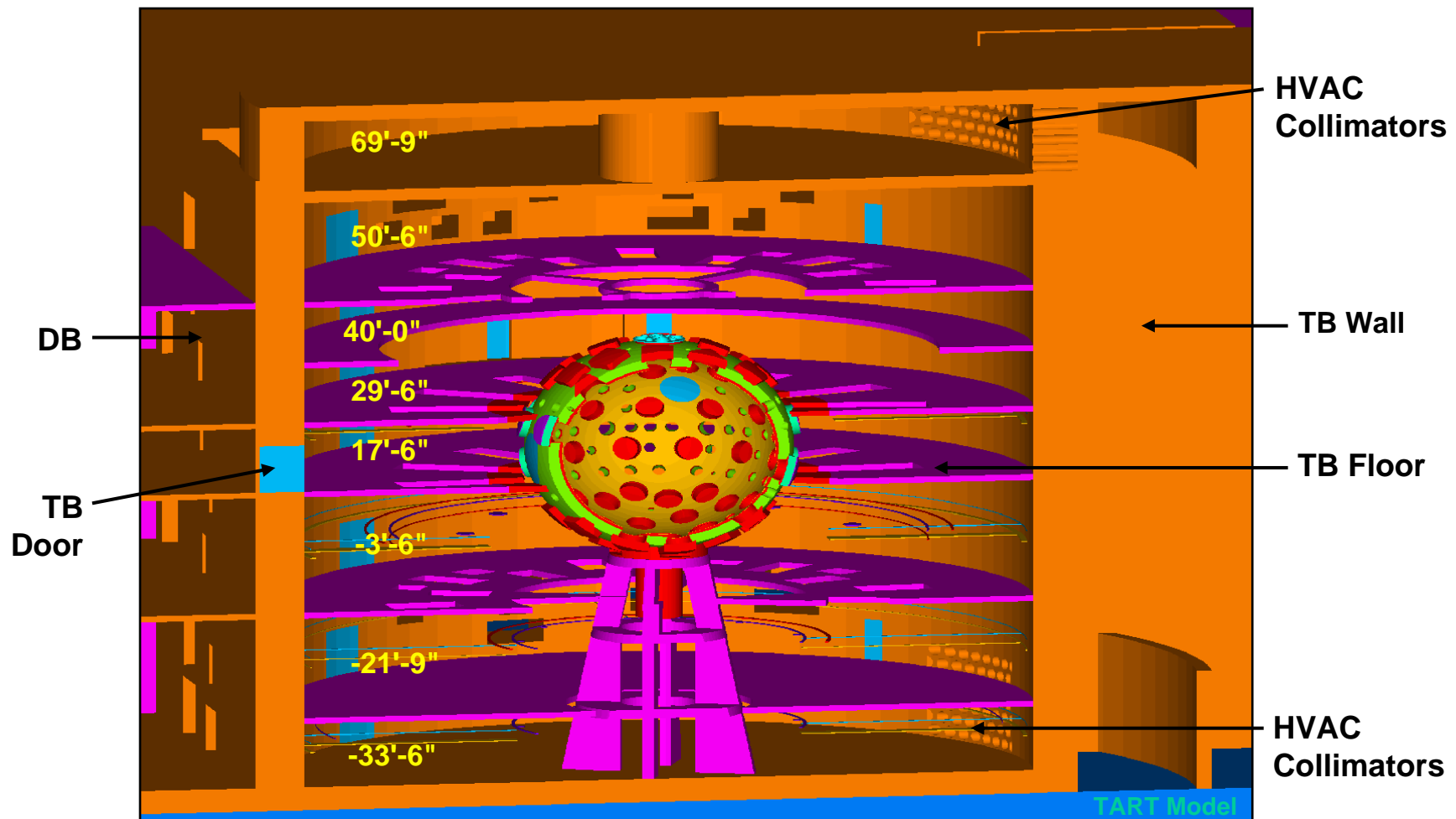


# Titan internal RB-230 theta and vertical orientations give different results



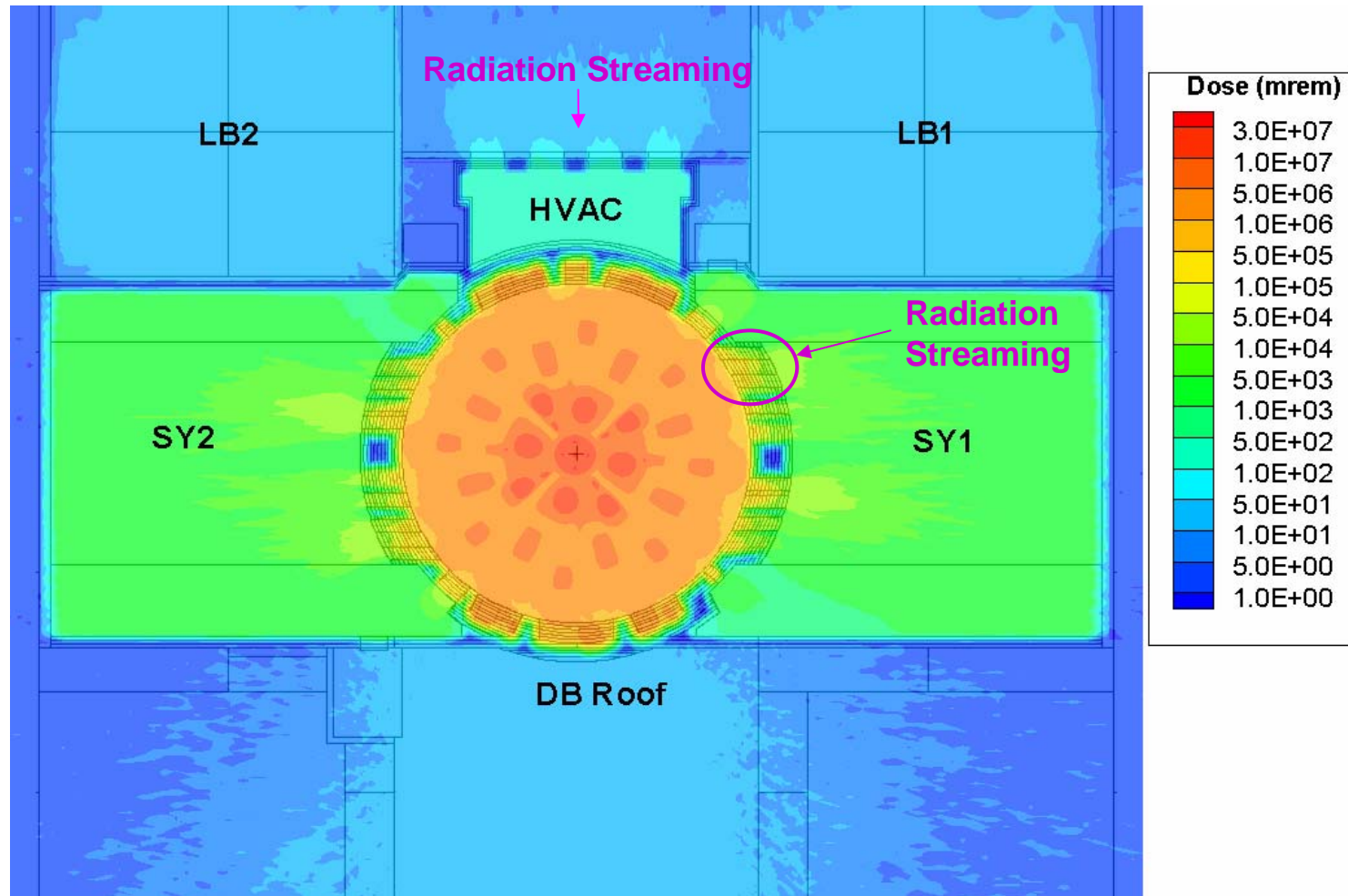
**Highest (~400 kV/m) observed for probe with vertical orientation, which is more sensitive to B field from electrons streaming away from target**

# Detailed Monte Carlo models are used to calculate the neutron and gamma radiation levels



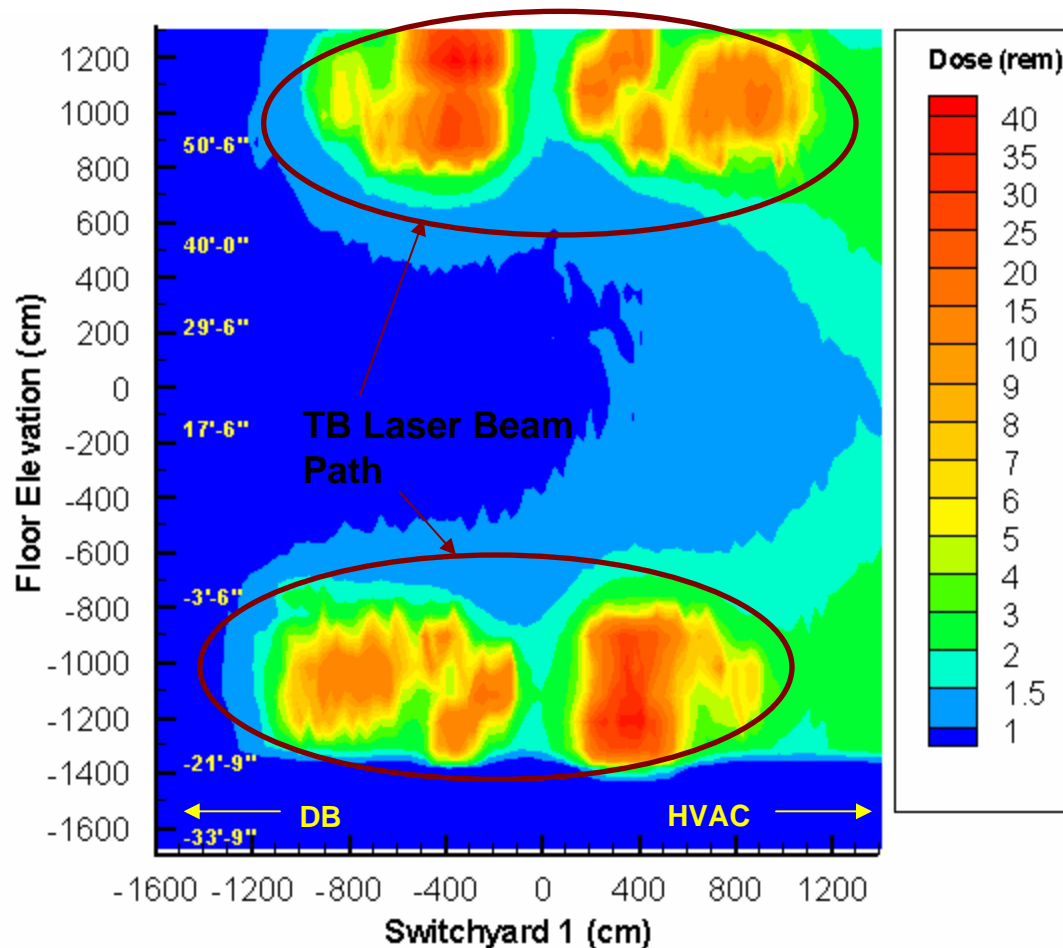


# Prompt dose map of the 50'-6" level per 20 MJ shot (with all TB and secondary doors)



Radiation streaming through the Target Bay penetrations dominate the prompt dose inside the Switchyards.

# Vertical display of the prompt dose per 20 MJ shot in SY1



Maximum prompt dose inside SY1 ranges from ~ 50 rem at -21'-9" and 50'-6" levels to ~ 2 rem at the 17'-6" level.

# Information from the Monte Carlo simulations are used in many ways

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- Results can be used to determine heating/melting/vaporization of components near TCC relevant to debris and shrapnel mitigation
- Results can be used to determine gamma loading on cables for system generated EMP simulations
- Simulations give number of gammas from collimators and other components near TCC that provide background for detectors
- Radiation levels determine the level of activation of all target bay structures, which is used to determine stay out time for workers
- Prompt radiation levels near diagnostics behind shield walls are used to determine appropriate additional shielding

# Summary

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- **All types of facility impact can be reduced with appropriate mitigation**
- **Complex 3D simulations and experiments are needed**
- **Assessments and mitigation requires significant lead time**
- **Major progress has been made in all areas**
- **This workshop highlights CEA & NIC progress in debris and shrapnel mitigation for NIF and LMJ**